Space Weather Technical Forecast

Issued on Monday, 25 July 2022 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of Active electron fluence. Slight Chance of R1/R2 throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has remained Low through the last 24 hours, with only minor C-class flares, with a peak of C2.6 at 24/0731UTC, which appeared to emanate from the vicinity of Ex-3056 on the northwestern solar horizon, perhaps concurrent with a southwest limb prominence eruption and Coronal Mass Ejection (CME). This prominence eruption has been analysed and is not Earth-directed. Coronagraph imagery was otherwise dominated by a large full-halo CME on Lasco C2 and C3 at the start the period, which has been analysed and is considered to be a far-sided event. Besides the far-sided full halo CME, there has been numerous faint CMEs seen in imagery during the 24 hours, which have been analysed and these are not considered to be Earth-directed. However, a filament eruption occurred at 24/1837UTC in the southeast quadrant, near AR3062, although there is currently no evidence of a CME in available imagery. Therefore, no Earth-directed CME's have been observed in available coronagraph imagery.

There are currently six sunspot regions on the visible disc, although all groups are unremarkable and all relatively stable, or have continued to fade during the period.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was characteristic of the tail end of influence of the 21 July CME, possibly segueing into the earlier incumbent high speed stream from coronal holes 01 and/or 02. The CME itself arrived at Earth prior to this 24-hour period, at 23/0258UTC. The solar wind speed has been mostly elevated, between 500-550km/s, with a steady declining trend towards the end of the period, as CME effects wane. The solar wind density has been mostly average throughout the period. The IMF showed a relatively stable magnitude around 5nT, with the north-south component (Bz) mostly weak, varying between -4nT and +4nT throughout the period. The phi angle was mainly negative (towards the Sun).The net result of the above solar wind measures was for mostly Quiet conditions, with an provisional Unsettled (Kp3) observed in the 00-03UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES16 was at Background levels.

High energy electron flux (greater than 2MeV) varied between Moderate and Normal Background levels, with a peak of around 926pfu observed around 24/1815UTC. Electron fluence has followed a declining trend, and has remained well below the Active threshold, falling to 2.59e7 integrated pfu by 25/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is Likely to remain Low, with a daily Slight Chance of M-class flares. Barring development, two further regions should leave the Earth-facing side of the Sun in the

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period, however the eastern solar hemisphere's far side is congested with the expected returning sunspot locations, such that activity ought to be maintained, pending proper analysis of any arrivals.

Solar Wind / Geomagnetic Activity: The 21 July CME is now largely thought to have passed. At present, no further Earth-bound CMEs feature in the forecast.

The current high speed stream from CH01/02 is the only one to feature in the forecast, and should wane in earnest to start the coming UTC working week. Quiet conditions should predominate from day 2 (26 July). However, by day 4 (28th July) conditions may become Unsettled as Earth possibly connects with CH04, although this carries low confidence.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is most likely to remain at Background levels.

The high energy electron flux (greater than 2 MeV) is expected to vary between Background and Moderate levels initially, with an increasing risk of exceeding the high (1e3 pfu) threshold into the new UTC working week. The rationale for this is waning geomagnetic activity and the realisation of the current high speed stream effects.

Electron fluence is forecast to follow a generally increasing trend through the period, with a Chance of exceeding the Active (1e8 integrated pfu) level, plateauing from Tuesday 26 July.

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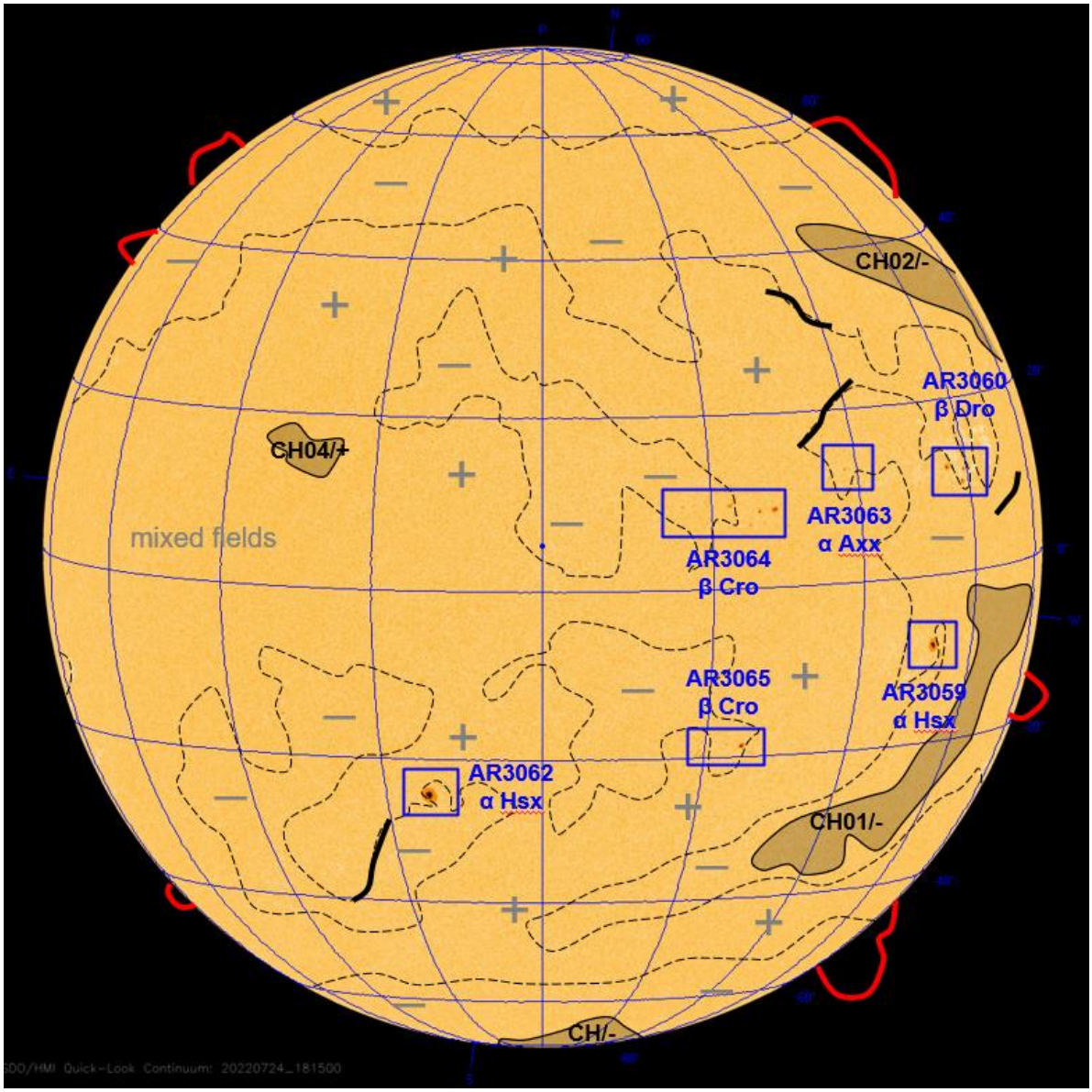
Figure 1. Solar Analysis Valid 24/1815UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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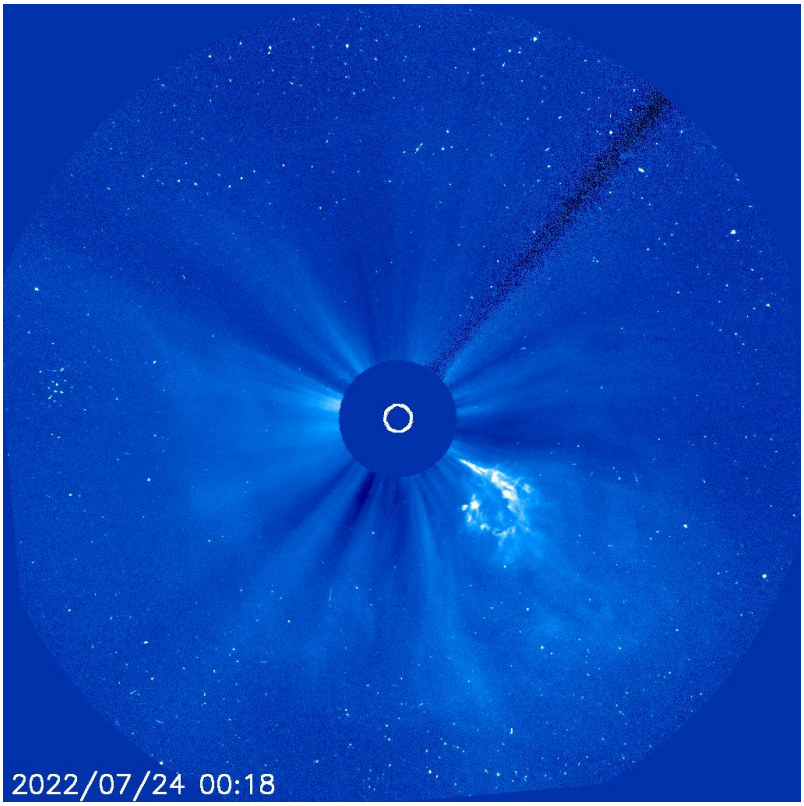
Geomagnetic Storms:
The 21 July CME's effects are now considered to have passed, with a resumption of the earlier fast wind from one or both of a pair of negative polarity high speed streams now in course. STEREO A MAG and PLASTIC data suggests that this fast wind ought to be in decline into the new working week UTC, such that by Day 2 (26 July) Quiet conditions ought to be predominant.
No further persistent features are in the current forecast, nor any transients, however confidence in the latter is lower than usual for a number of events observed in the past 24 hours. There is a slight chance of Earth connecting with CH04 late on Day 4 (28th July), which may bring Unsettled intervals by the end of the period. Low confidence.

By far the most notable event in the past 24 hours in coronagraphs was a large far-sided CME, visible as a full halo on Lasco, but with the bulk of material appearing to leave the disc to the rear-facing southwest. Accompanying this was a halo shock and perhaps also a tied portion of ejecta heading northeast on the far side. Just prior to this event there was some movement visible in a filament on the Earth-facing southwest disc, as well as a few minor dimmings in AIA211 through the course of the 24th July, mostly in the western solar hemisphere.

Figure 2: LASCO C3 imagery shows the far-sided CME, with full shock visible and the main core of the CME heading southwest.



There was a more distinct prominence eruption observed in the period from the southwest limb around 24/0730UTC, which has been analysed and is not Earth-directed.

Another filament eruption occurred later in the period in the southeast quadrant, near AR3062, at 24/1837UTC, although there is currently no CME evident with this event in available imagery.

At the time of writing, there is no confirmed CMEs with any Earth-bound component in the forecast.

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Met Office Space Weather Technical Forecast

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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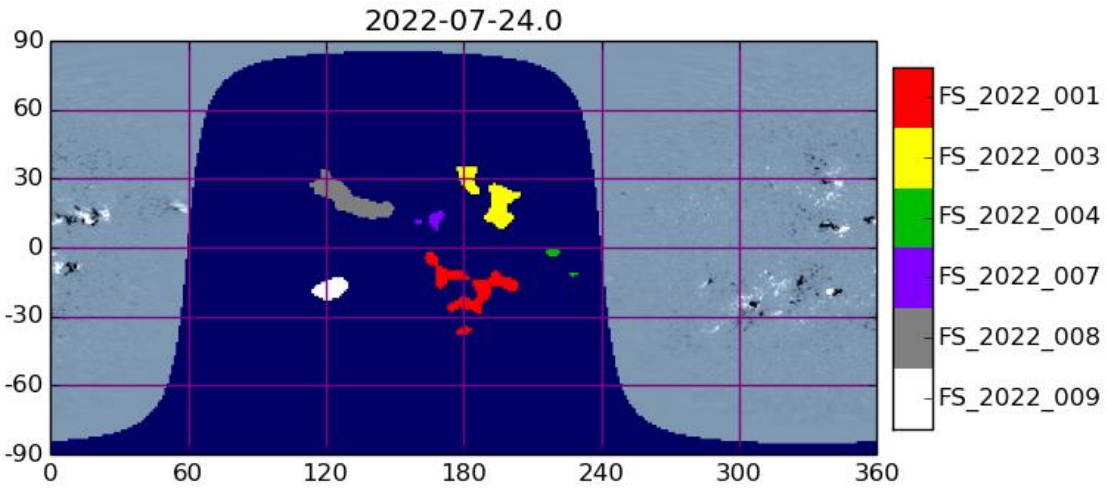
Radio Blackouts - X-Ray Flares:
Solar activity has been Low over the last 24 hours, with modest C-class flare observed. There are currently six sunspot regions on the visible disc, which are all relatively stable and unremarkable.

Barring development, two further regions should leave the Earth-facing disc in the period, however the eastern hemisphere far side is congested with the expected returning Carrington locations of numerous regions in the four days, such that activity ought to be maintained, pending proper analysis of any arrivals.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Far-side sounding, which shows conjection of possible active regions directly on the far-side of the Sun. This may be a glimpse of the possible size and scale of upcoming eastern solar horizon arrivals during the forecast period.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at background levels. As most regions are small and relatively magnetically simple, the risk of a proton enhancement is very low.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to respond with an increasing amplitude oscillation in the coming 24 hours, probably in a manner roughly akin to the past rotation. The rationale for this is that the fast wind from the current persistent coronal hole(s) CH01/02 appears to have out-lasted the 21 July CME's effects to continue to charge the Van Allen belts to some degree.

The risk of 24-hour integrated fluence breaching Active is therefore upwards, probably finding its level at the very start of the coming working week UTC before stabilising.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	30	40	40	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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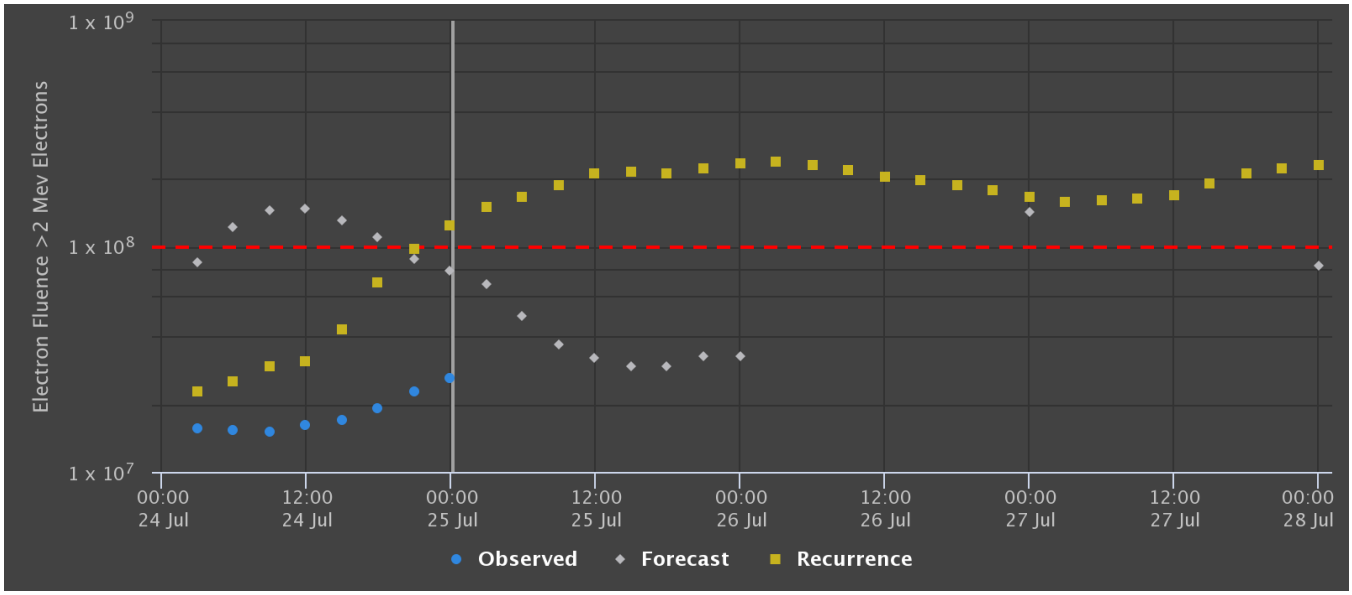
Figure 4: REFM electron fluence, shows a rising trend following the recent CME effects and the current waning effects of a fast wind from CH01 and CH02.



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